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(54) Bicomponent fibers and webs made therefrom.

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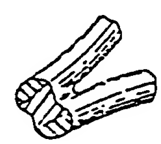

FIG. 2B

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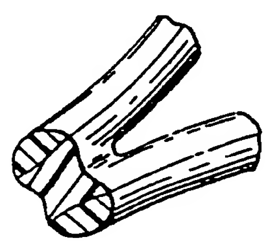

EP 0 138 549 A2

Description

BICOMPONENT FIBERS AND WEBS MADE THEREFROM

Technical Field

For several years, bicomponent fibers in standard textile sizes, e.g., with cross-sectional diameters of at least about 15 micrometers, have been prepared and commercially marketed for a variety of purposes. The present invention goes beyond such previous work by teaching fibers made from certain combinations of components, having particular physical properties, that open the way to new uses for the bicomponent fibers. In addition, the present invention provides fibrous webs and other fibrous products that comprise the new fibers.

Disclosure of Invention

In brief summary, the new fibers of the invention comprise a first polymeric material extending longitudinally along the fiber through a first portion of the cross-sectional area of the fiber and a second polymeric material adhered to the first polymeric material and extending longitudinally along the fiber through a second portion of the cross-sectional area of the fiber; with the first polymeric material being at least partially amorphous but capable of undergoing a crystallization at a temperature less than the melting temperature of the second polymeric material.

Fibrous webs made from fibers as described have the advantage that they can be molded into fibrous shape-retaining forms by processing the web while it is constrained in a desired shape so as to crystallize the first polymeric material. As one example, fibrous webs of the invention may be molded into cup shapes such as used in disposable molded masks or respirators.

Preferably, the new fibrous webs of the invention comprise bicomponent blown fibers, preferably averaging less than 10 micrometers in diameter. Such fibers can be

prepared by simultaneously feeding different polymeric materials in molten form to the same die cavity of a fiber-blowing apparatus where the materials form a layered liquid mass, and extruding the layered mass through a row of side-by-side orifices into a high velocity gaseous stream. The portions of material extruded through each die orifice are attenuated and drawn into fibers by the high-velocity gaseous stream, and are then carried to a collector such as a moving screen, where the mass of fibers is deposited as a coherent and tangled web. Surprisingly the layered liquid mass presented to the individual side-by-side orifices passes through these orifices without undue turbulence or disruption. The layered structure uis maintained in the individual extruded streams, and the layered individual streams are then drawn to bicomponent fibers in a high-velocity gaseous stream.

Collected webs of blown bicomponent fibers tend to be loftier than conventional blown fiber webs, because the bicomponent fibers tend to be curly, e.g., as a result of differences in shrinkage for the different components of the fibers. Further these lofty webs have unique filtration characteristics, with lower pressure drops then conventional blown fiber webs, coupled with high filtration efficiencies. Also, the side-by-side presence of different polymeric materials and individual blown fibers offers other unique properties.

A particularly unique example of a web of the invention includes fibers that comprise polyethylene terephthalate as one component (polyethylene terephthalate can be obtained in the amorphous form in melt-blown fibers) and a thermosoftening polymer such as polypropylene as a second component. When the collected web is molded or conformed in the presence of heat, the amorphous polyethylene terephthalate first crystallizes at a temperature lower than the softening point of the polypropylene, whereupon the fibers tend to become set in the shape they are held by the molding apparatus. As it crystalizes, the

polyethylene terephthalate also assumes a melting point higher than the melting point of the polypropylene. The temperature of the web can then be further elevated above the softening point of the polypropylene, whereupon the fibers become bonded at their points of intersection by coalescence or fusion of the polypropylene at those points of intersection. The crystallized polyethylene terephthalate serves as a supporting matrix during this softening process, whereby the web retains its porosity and fibrous nature, while the fibers become bonded together so that after cooling, the web retains its molded shape.

Although webs of the invention preferably take the form of blown fibrous webs, other bicomponent fibers than blown fibers may be used either in combination with blown fibers or by themselves or with other kinds of fibers.

Brief Description of the Drawings

Figure 1 is a schematic diagram of apparatus used in practicing the present invention;

Figure 2 is a greatly enlarged sectional view of a fiber intersection in a portion of a web of the invention; and

Figures 3 and 4 show a representative face mask that incorporates a web of blown bicomponent fibers of the present invention, Figure 3 being a perspective view showing the mask in use, and Figure 4 being a sectional view along the lines 4-4 of Figure 3.

Best Mode for Carrying Out Invention

A representative apparatus useful for preparing a blown-fiber web or sheet product of the invention is shown schematically in Figure 1. Part of the apparatus for forming blown fibers is described in Wente, Van A., "Superfine Thermoplastic Fibers" in Industrial Engineering Chemistry, Vol. 48, p. 1342 et seq. (1956), or in Report No. 4364 of the Naval Research Laboratories, published May 25, 1954, entitled "Manufacture of Superfine Organic

Fibers," by Wente, V. A.; Boone, C. D.; and Fluharty, E. L. This portion of the illustrated apparatus comprises a die 10 which has a set of aligned side-by-side parallel die orifices 11, one of which is seen in the sectional view through the die. The orifices 11 open from a central die cavity 12.

In the illustrated embodiment of the invention two different polymeric components are introduced into the die cavity 12 through extruders 13 and 14 and conduits 15 and 16. In the die cavity 12 the components form a layered mass (i.e., a mass in which the different components are segregated as discrete layers), which is extruded through the side-by-side orifices 11. Orifices 18 are disposed on either side of the row of orifices 11 for conveying heated air at a very high velocity. The air draws out and attenuates the extruded polymeric material into a mass of fibers, which solidifies after a short travel in the gaseous stream. The solidified fibers travel to a collector, which may take the form of a finely perforated cylindrical screen or drum, or a moving belt, where they are collected as a coherent entangled web. The collected web of fibers can then be removed from the collector and wound in a storage roll. Gas-withdrawal apparatus may be positioned behind the collector to assist in deposition of fibers and removal of gas.

Although the illustrative apparatus shown in Figure 1 has a single undivided die cavity into which two different polymeric materials are introduced, in different embodiments a separator plate is included in the die cavity to keep the polymeric materials separate until immediately prior to reaching the exit area of the orifices. However, even without such a separator plate, and whether or not the die is arranged horizontally as shown in Figure 1 or vertically, the different polymeric materials or components pass through the orifices as layered streams without being disrupted by turbulence or because of different specific gravities, and bicomponent fibers are formed. The

viscosities of the different polymeric materials being passed through a die should be generally similar, which can be achieved by controlling the temperature and residence time in the extruder, composition of the polymeric material, etc.

The extruded bicomponent fibers are not always arranged as semi-cylinders. For example, a first component may be disposed more in the center of the fiber, with a second component wrapped partially or completely around the first component. In the latter case the first component becomes a core area and the second component becomes a sheath. More than two different polymeric materials may be included in the fibers, e.g., as separate layers, and the term "bicomponent" is used herein to include fibers that have more than two components. The components generally extend continuously along the length of the fiber.

The blown fibers are preferably microfibers, averaging less than about 10 micrometers in diameter, since the components in such fibers are more strongly adhered. Also fibers of that size offer improved filtration efficiency and other beneficial properties. Very small fibers, averaging less than 5 or even 1 micrometer in diameter, may be blown, but larger fibers, e.g., averaging 25 micrometers or more in diameter, may also be blown, and are useful for certain purposes such as coarse filter webs.

Other fibers may be mixed into a fibrous web of the invention, e.g., by feeding the fibers into the stream of blown fibers before they reach a collector. U.S. Pat. 4,118,531 teaches such a process for introducing crimped staple fibers which increase the loft of the collected web, and U.S. Pat. 3,016,599 teaches such a process for introducing uncrimped fibers. The additional fibers can also have the function of opening or loosening the web, of increasing the porosity of the web, and of providing a gradation of fiber diameters in the web. The most useful results have been obtained by including staple fibers in amounts up to about 90 volume percent, with the amount

preferably being less than about 50 volume percent. The staple fibers may be bicomponent fibers, and may include one or more components that are chemically of the same composition as in the blown bicomponent fibers, and the staple fibers may become bonded to the blown fibers during processing. Also particulate matter may be introduced into the web in the manner disclosed in U.S. Pat. 3,971,373, e.g., to provide enhanced filtration, and the particles may be bonded to the fibers, e.g., by controlling process conditions during web formation or by later heat treatments or molding operations.

Blown fibrous webs are characterized by an extreme entanglement of the fibers, which provides coherency and strength to a web and also adapts the web to contain and retain other materials, such as particulate materials or other fibers. The aspect ratio (ratio of length to diameter) of blown fibers is essentially infinite (e.g., generally at least about 10,000 or more), though the fibers have been reported to be discontinuous. The fibers are long and entangled sufficiently that it is generally impossible to remove one complete fiber from the mass of fibers or to trace one fiber from beginning to end.

A completed web or sheet product of the invention may vary widely in thickness. For most uses, webs having a thickness between about 0.05 and 5 centimeters are used. For some applications, two or more separately formed webs may be assembled as one thicker sheet product. Also webs of the invention may be prepared by depositing a stream of fibers onto another sheet material such as a porous nonwoven web which is to form part of the completed web. Other structures, such as impermeable films, can be laminated to a sheet product of the invention through mechanical engagement, heat bonding, or adhesives.

Webs of the invention may be further processed after collection, e.g., compacting through heat and pressure to control sheet caliper, to give the web a pattern or to increase the retention of particulate materials.

The fibers may be formed from a wide variety of fiber-forming materials. Representative combinations of polymeric materials for the components of a fiber include: polyethylene terephthalate and polypropylene; polyethylene terephthalate and linear polyamides such as nylon 6; Also, different materials may be blended to serve as one component of a bicomponent fiber. In addition, blown fibers of different combinations of materials may be used in the same web either in mixture in one layer (e.g., by collecting a mixture of fibers from two dies) or in different layers.

Fibrous webs of the invention made from bicomponent fibers other than blown fibers may be made by other techniques, such as by air-laying process.

The polymeric components in a two-component bicomponent fiber of the invention are most often included in approximately the same volume amounts, or in amounts ranging between about 40 and 60 volume percent for each of the components, but can vary outside that range.

As previously indicated, a particularly useful combination of components in bicomponent fibers of the invention includes a first, crystallizable, component such as amorphous polyethylene terephthalate and a second, thermosoftening, component such as crystalline polypropylene or amorphous polystyrene. Although polyethylene terephthalate fibers prepared by typical spinneret drawing inherently tend to be crystalline, blown polyethylene terephthalate fibers tend to be amorphous (because of the rapid quenching effect of the air stream that attenuates and transports the fibers). When a web comprising blown fibers that contain amorphous polyethylene terephthalate is placed in a mold and heated to a temperature higher than the temperature at which the polyethylene terephthalate becomes crystalline, the polyethylene terephthalate-containing fibers first assume the shape in which they are pressed by the mold. After the heating process, the fibers retain their shape because of their newly crystallized

state. If the crystallizing temperature to which the web is heated is lower than the temperature at which the second component of the fibers softens, as is the case with polypropylene, the second component provides a fibrous support in which the first component is intimately and continuously supported over its length, thus helping to maintain the individual fibers as discrete fibers, rather than allowing the web to collapse or coalesce to a film-like condition. The polyethylene terephthalate softens as it is heated to the crystallizing temperature, and some bonding occurs between fibers at intersections where the polyethylene terephthalate component of one fiber engages the polyethylene terephthalate component of another fiber or fiber segment.

Crystallization of the polyethylene terephthalate raises the softening point of the polyethylene terephthalate, and in fact, the softening point is raised past the softening point of the polypropylene. The result is that the web then can be heated to a higher temperature, past the softening point of the polypropylene, with the polyethylene terephthalate component now providing a fibrous support that prevents the web from collapsing or coalescing. Also, during molding operations the web is surprisingly inhibited from sticking to the mold parts, which can occur with webs of fibers that consist wholly of polypropylene. Bonds are formed between fibers where polypropylene components engage. A well-bonded molded web is formed which durably retains its shape.

Other crystallizable polymeric materials such as other polyesters and polyamides can also be obtained in an amorphous form in blown fibers, e.g., by the quenching effect of the process air or by spraying water onto the fibers as they travel to the collector, to give the fibers the described moldable character.

Figures 2a and 2b illustrate a representative fiber intersection in a web of the invention, with Figure 2a showing an exterior view of the fibers, and 2b showing a

cross-section through the fibers at their point of intersection.

Figure 3 shows a perspective view of a cup-shaped face mask or respirator formed from a fibrous web of the invention, and Figure 4 is a cross-section through the web. An advantage of the invention is that a web of the invention may be used as the sole sheet product of the face mask, as shown in Figure 4. Such a construction avoids sandwiching a web of blown microfibers between two molded fibrous webs which serve as the exterior and interior of the web, and which hold the blown microfiber web in the cup-like shape of the face mask or respirator. Lofty low-pressure-drop masks or other molded products may be prepared because bonding between fibers and shaping of the web occurs readily through the combination of properties offered by the bicomponent fibers, such as the noted crystallizability and shapeability of polyethylene terephthalate fibers and the fusability of polypropylene heated to its softening point.

Webs of the invention may be electrically charged to enhance their filtration capabilities, as by introducing charges into the fibers as they are formed, in the manner described in U.S. Pat. 4,215,682, or by charging the web after formation in the manner described in U.S. Pat. 3,571,679. Polypropylene is desirably included as a component in electrically charged fibers of the invention because it retains a charged condition well. Bicomponent fibers of the invention offer the benefit of including polypropylene together with another component that provides other useful properties.

Another advantage of bicomponent fibers of the invention is that a first material which is more susceptible to melt-blowing, e.g., because of viscosity and flow characteristics, can be used as a first component. A second material that is less susceptible to melt-blowing can be used as a second component to obtain well-formed bicomponent fibers. Both materials extend continuously

over the length of the fiber.

Fibrous webs of the invention may include other ingredients in addition to the microfibers. For example, fiber finishes may be sprayed onto a web to improve the hand and feel of the web. Additives, such as dyes, pigments, fillers, abrasive particles, light stabilizers, fire retardants, absorbents, medicaments, etc., may also be added to webs of the invention by introducing them to the fiber-forming liquid of the microfibers, spraying them on the fibers as they are formed after the web has been collected, etc.

The invention will be additionally illustrated by the following examples. The examples report measured values for the quality of filtration for dioctylphthalate aerosols, which were measured by using an Air Techniques Inc. Q127 DOP Penetrometer. This instrument thermally generates a monodispersed 0.3 micrometer diameter dioctylphthalate particle at a concentration of 100 micrograms per liter of air and presents the particle-containing stream to the test web at a rate of 32 liters per minute and a face velocity of 5.2 centimeters per second. The quality of filtration index is equal to the negative natural logarithm of the fraction of penetration through the fibrous web divided by the pressure drop through the web in millimeters of water. The higher the quality of filtration index, the better.

Example 1

Preparation of Fibrous Web

A fibrous web was prepared using apparatus as shown in Figure 1 and forming the fibers from polyethylene terephthalate having an intrinsic viscosity of 0.59 and polypropylene having a melt flow of 35. The extruder for the polyethylene terephthalate had a screw diameter of 1 inch (2.54 centimeters) and a length to diameter ratio of 25. The extruder for the polypropylene had a screw diameter of 1-1/2 inches (3.8 centimeters) and a length-to-diameter

ratio of 25. The first extruder elevated the temperature of the polyethylene terephthalate through a temperature profile of 400, 510, and 600°F (204, 266, and 316°C), and the polyethylene terephthalate reached the die with a temperature of 615°F (323°C). The second extruder elevated the temperature of the polypropylene through a temperature profile of 350, 450 and 500°F (177, 232, and 260°C), and the polypropylene had a temperature of 490°F (254°C) upon reaching the die. The polyethylene terephthalate introduced into the extruder had first been dried in a desiccant dryer for three hours at 350°F (177°C).

The two polymers were introduced into the die cavity in an amount sufficient to provide about 50 weight-percent polyethylene terephthalate and 50 weight-percent polypropylene, and were extruded through the die orifices 11 at a rate of about one pound per hour per inch width of die (0.18 kilogram per hour per centimeter). The die had about 55 orifices per inch width (22 per centimeter). Air heated to 750°F (400°C) was forced through the air orifices 18 of the dies at a rate of 20 cubic feet per minute at 20 pounds per square inch (0.57 cubic meter per minute at a pressure of 1.4 kilograms per square centimeter). Different zones of the die were heated to different temperatures, the first zone (i.e., including the die orifices) being heated to 600°F (315°C), and the rear zone being heated to 570°F (300°C).

Bicomponent blown fibers were collected on a screen-type collector which was spaced about 38 centimeters from the die and was moving at a rate of 3 meters/minute. The collected web weighed about 101 grams per square meter and was about 5 millimeters in thickness. When tested at a face velocity of 32 liters per minute, the web exhibited a pressure drop of about 0.1 millimeter water.

The collected fibers had an average diamter of 4 micrometers. The two components extended continuously along the length of the fibers, and in cross-section were arranged generally as semi-cylinders.

A web as prepared was sectioned by cutting with a razor blade and examined under a microscope, and it was found that the fibers of the web remained intact. By contrast, when a web of 30 micrometer-diameter fibers of the same two components prepared in a spinneret was cut in the same manner, the fibers tended to split apart.

Example 2

Example 1 was repeated with several samples being made from the described polymeric components: in sample A the fibers comprised 70 weight-percent polypropylene and 30 weight-percent polyethylene terephthalate; in sample B the fibers comprised equal weight amounts of polypropylene and polyethylene terephthalate; and in sample C the fibers comprised 30 weight-percent polypropylene and 70 weight-percent polyethylene terephthalate. Two comparative samples M and N were also prepared. Comparative sample M comprised fibers that consisted only of polypropylene and comparative sample N comprised fibers that consisted only of polyethylene terephthalate. The dioctylphthalate filtration quality indexes measured for the different samples of the invention were 0.58 for sample A, 1.39 for sample B, and 1.0 for sample C. Comparative sample M exhibits an index of 0.25 and comparative sample N, 0.5.

Example 3

Molding of fibrous web of Example 1

Fibrous web as described in Example 1 was placed between the mating parts of a cup-shaped cast aluminum mold. The top, or female, half of the mold was heated to 210°F (98°C). The male, or bottom, half to 195°F (90°C), and the web was left in the mold for 3 seconds. Upon removal from the mold the web retained its molded shape. By viewing the web under a polarizing light microscope, it was determined that the polyethylene terephthalate portions of the fibers had become crystallized, and that some

bonding between fibers had occurred at points of engagement by polyethylene terephthalate portions of the fibers.

The molded web was then heated in an air oven for 30 seconds to a temperature of about 170°C. Upon re-examination of the web under a microscope it was seen that polypropylene portions of the fibers at points of intersection of the fibers had fused or coalesced together, and to a lesser extent there were bonds between polyethylene terephthalate portions of the fibers at points of intersection. In other words, the heating in the air oven had given the molded web further permanence of the molded shape, i.e., had further "heat-set" the molded web into its molded shape.

The effects of heating the molded webs in an air oven to different temperatures were examined with a series of tests. Flat webs were first heated for about 5 minutes at 250°F (121°C) to crystallize the polyethylene terephthalate portion of the fibers, thereby simulating the conditions that occur during the molding operation described above. The webs were then exposed in an air oven to the temperatures listed in Table I, described as heat-setting temperatures. The degree of shape-retention was indicated by subjecting the web to compression and measuring the change in thickness of the web. The original thickness of the web before molding was 1.6 centimeters, measured while the web was under a pressure of 2.3 grams per square centimeter to provide a standard measure of thickness. The molded, heat-set web was then compressed by applying a total pressure of 7 grams per square centimeter to the web. The percent compression was equal to the initial thickness minus the final thickness divided by the initial thickness, the quotient being multiplied by 100 to obtain percent. The percent compression obtained for different heat-setting temperatures is given in Table I.

TABLE I

Heat-Setting Temperature (°F)	(°C)	Percent Compression (Percent)
250	121	32.5
275	135	23.5
300	149	24
325	163	21
350	177	6
400	204	7.3

The above experiments indicate that significant heat-setting or additional bonding of fibers in the web occurs, especially at a temperature between 325 and 350°F (163 and 177°C). The latter temperature is about equal to the melting point of polypropylene, and which indicates that the fibers are being bonded at their intersection points by coalescence of the polypropylene.

Example 4

A fibrous web was prepared by mixing 60 weight-percent bicomponent fibers prepared in the manner described in Example 1 with 40 weight-percent polyethylene terephthalate macrofibers (15-denier fibers having lengths of about 1-1/4 inches (3.2 centimeters), with 6.5 ± 1 crimps per inch (2.5 ± 0.4 crimps/centimeter). The web was prepared by introducing the macrofibers from a lickerin roll into the blown fiber stream in the manner described in U.S. Pat. 4,118,531. The resulting web, which had a basis weight of 250 grams per square meter, was molded in a mold as described in Example 5 using a temperature of 275°F (135°C) for the top half of the mold and a temperature of 210°F (98°C) for the bottom half. The sample was left in the mold for 26-1/2 seconds and the mold parts were pressed together at a pressure of 8 pounds per square inch. The molded web was heat set by heating in a forced air oven for one minute at 350°F (177°C).

The sample exhibited a dioctylphthalate filtration quality index of 2.8.

Compression tests were performed on various samples of the product of this example. At 50 grams loading, which equaled 0.89 gram per square centimeter pressure, the web as made exhibited a thickness reduction of 12%, and at 150 grams loading exhibited a thickness reduction of 41%. After the web was heat set at 275°F (135°C) for five minutes the web exhibited a thickness reduction of 8% at 50 grams loading and 25% at 150 grams loading. When heated a second time at 350°F (176°C) for one minute, the web exhibited a thickness reduction of 5% at 50 grams loading and 16% at 150 grams loading.

Example 5

A web was prepared as described in Example 1. A rectangular sample of this web measuring 5 cm by 10 cm and weighing 0.52 gms was placed into a circulating hot air oven at 275°F (135°C) for 1 minute to crystallize the PET component. The web was then placed in a container with 20 gms of 320 grit aluminum oxide abrasive granules, and the container placed into a circulation hot air oven at 350°F (176°C) for about 5 minutes. The container was then rapidly shaken while hot. The final web had a weight of 1.28 gms. Light micrographs showed the aluminum oxide abrasive to be adhered in the web to the polypropylene side of the microfibers.

CLAIMS

1. A fibrous web comprising bicomponent fibers that individually comprise a first polymeric material extending longitudinally along the fiber through a first portion of the cross-sectional area of the fiber and a second polymeric material extending longitudinally along the fiber through a second portion of the cross-sectional area of the fiber; characterized in that the first polymeric material is amorphous but undergoes crystallization at a temperature less than the melting temperature of the second polymeric material, which causes the bicomponent fibers to retain the shape they assume during crystallization, whereby the web can be molded to a fibrous shape-retaining form.

2. A fibrous web of claim 1 in which the crystallization raises the melting temperature of the first polymeric material to a temperature higher than the melting temperature of the second polymeric material.

3. A fibrous web of claim 1 or 2 in which the first polymeric material comprises polyethylene terephthalate.

4. A fibrous web of claim 1, 2 or 3 in which the second polymeric material comprises polypropylene.

5. A fibrous web of any of claims 1-4 conformed to a non-planar shape and held in that shape by said crystallization of the first polymeric material.

6. A fibrous web of any of claims 1-5 in which the fibers are bonded by fusing of one of the polymeric materials at intersections of the fibers.

7. A fibrous web of any of claims 1-6 in which the bicomponent fibers comprise blown fibers.

8. A fibrous web of claim 7 in which the bicomponent blown fibers average no more than 10 micrometers in diameter.

9. A fibrous web of claims 7 or 8 in which staple fibers are dispersed with the blown fibers.

10. A fibrous web of any of claims 1-9 which includes fibers that carry an electric charge.

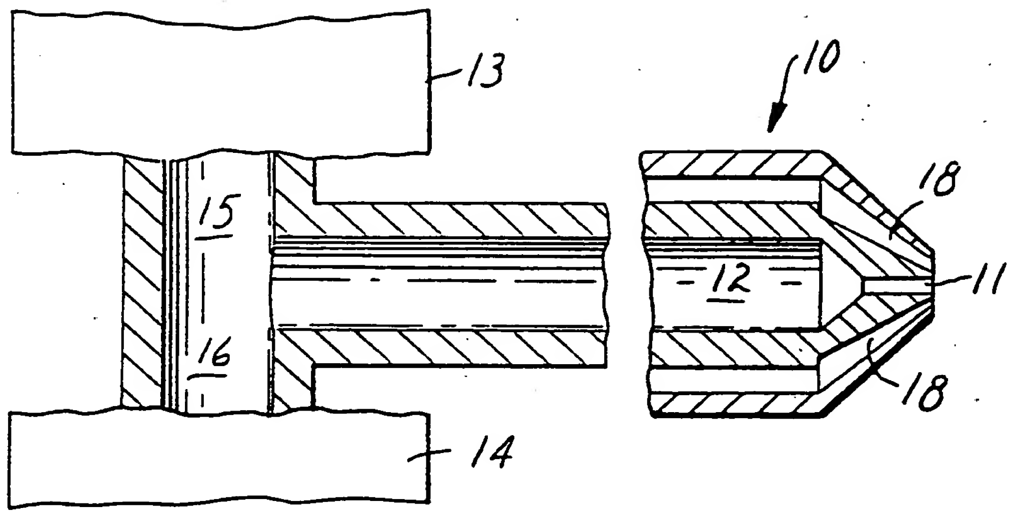

FIG.1

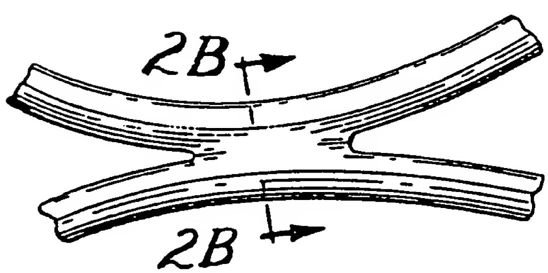

FIG.2A

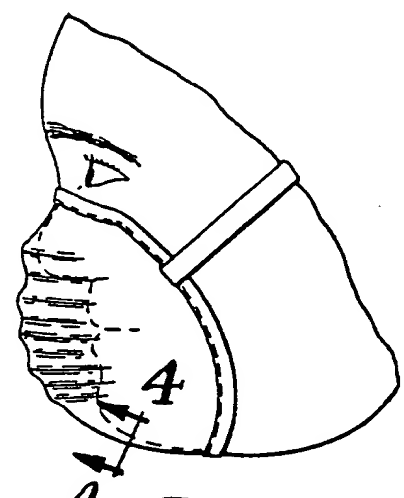

FIG.3

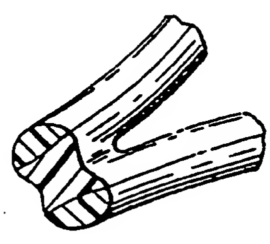

FIG.2B

FIG.4

European Patent Office

EUROPEAN SEARCH REPORT

0138549

Application number

EP 84 30 6850

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl 4)
A	US-A-4 164 600 (MONSANTO) * Claims 1,4,11,12; column 6, lines 64-68; column 7, lines 1-38 *	1,3,6	D 04 H 1/56 D 04 H 1/54
A	US-A-3 333 585 (MINNESOTA MINING & MANUFACTURING CO.) * Claim 1; column 5, line 68 - column 6, line 68 *	1,3,5,6	
D,A	US-A-4 215 682 (MINNESOTA MINING & MANUFACTURING CO.) * Claims 1,2,4,9,10,11 *	1,4,5,6,7,9,10	
			TECHNICAL FIELDS SEARCHED (Int Cl 4)
			D 04 H D 01 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16-07-1986	CATTOIRE V.A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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